Transoral Robotic Surgery (TORS)

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Minimally invasive surgery has revolutionized surgical practice in the past two decades and is quickly becoming the standard of care across multiple disciplines. In head and neck surgery, organ-preservation protocols and transoral laser microsurgery have laid the foundation for the recent development of transoral robotic surgery (TORS), which uses the da Vinci surgical robot to orally approach the throat rather than traditional cervical incisions into closed neck spaces. In 2006, they described its application in human patients for resection of oropharyngeal squamous cell carcinoma (OPSCC). The FDA approved the use of TORS in December of 2009 for resection of selected head and neck tumours.

In December of 2010, Dr. Kevin Fung and Dr. Anthony Nichols from the Department of Otolaryngology – Head and Neck Surgery at the University of Western Ontario (UWO) performed the first TORS procedure in Canada: a TORS supraglottic laryngectomy (Figure 1). Other options for the patient were either open supraglottic laryngectomy with bilateral neck dissections or full course radiotherapy for 7 weeks (70 Gy). With TORS, the patient was able to avoid temporary tracheotomy and nasogastric tube (NG) feeding, and with negative margins and nodes the patient completely avoided post-operative radiotherapy as well. This case highlights some of the advantages of TORS for the treatment of head and neck cancer, which will be discussed further below along with details of the procedure and future directions.

SURGICAL PROCEDURE

The Da Vinci surgical platform consists of a console, a surgical cart, and a manipulator unit. The TORS procedure involves the transoral insertion of two wristed instruments arms and a central 3D endoscope. The console offers the surgeon a three-dimensional magnified view and allows control of the twoendowristed robotic arms, which helps to enhance manual dexterity. The system allows for the surgeon’s hand movements to be motion-scaled and thereby eliminates physiological hand tremor.

The first clinical use of the Da Vinci robot for head and neck surgery involved the removal of a benign oropharyngeal lesion and a thyroidectomy. Applications have expanded to procedures such as parathyroidectomy and skull based surgery. However, the main application of TORS is in the treatment of malignancies caused by squamous cell carcinoma (SCC) which can involve the oral cavity, oropharynx, hypopharynx, and larynx. Such cases include TORS tonsillectomy, TORS tongue base resection, and TORS supraglottic laryngectomy.

The primary advantages of robotic surgery include the minimization of surgical trauma, superior visualization, improved precision, and the ability to recreate an open surgical experience. Additional advantages include better safety and morbidity outcomes for the patient, which are discussed below. Conversely, there are certain disadvantages of TORS such as a confined operative field and financial limitations such as the high initial cost of the robotic system (over a million dollars) and the high cost of instruments (about one thousand dollars per case). However, in centers where a robotic console already exists for general or urologic surgery, adding head and neck cases will augment value of the machine and increase productivity.

OUTCOMES

Due to its relative infancy, there are currently no controlled studies comparing TORS procedures to their open surgical counterpart or primary chemoradiation for the treatment of oropharyngeal cancer. However, different case series of patients who underwent resection of oropharyngeal squamous cell cancer (OPSCC) by TORS show promising results and highlight several advantages.

SAFETY

No major complications and acute sequelae of TORS have been reported. Minor complications include transoral bleeding, exacerbation of sleep apnea from postoperative swelling, development of moderate trismus, and temporary hypernasality of voice. In general, patients who undergo TORS have lower estimated
blood loss (<200 mL) when compared to open surgery, and none have required blood transfusions. TORS patients also have a shorter hospital length of stay, as most are discharged six days after OPSCC resection.3,4 In contrast, patients after open supraglottic laryngectomy would typically stay 10-14 days in hospital post-operatively.

ONCOLOGICAL

OPSCC resection with negative margins in all patients was reported by different case series ranging from 12 to 45 patients.1,4,11,14-16 For example, in the case series from the Mayo clinic, all 45 patients with either base of tongue or tonsillar fossa tumors had negative margins after TORS resection, and 12 were able to avoid adjuvant radiation. A recent publication from the University of Pennsylvania reports that, out of 50 cases, 2 patients developed distant metastases and one patient developed both local and distant recurrence of disease following TORS resection of OPSCC (mean follow-up: 2 years). 19 More long-term oncological outcomes are unavailable at this time.

FUNCTIONAL

Preserving airway and swallowing function is an important determinant of quality of life following oropharyngeal surgery, and largely depends on whether the patients receive post-operative radiation or chemotherapy. To date, none of the four patients treated with TORS at UWO have required adjuvant radiation therapy as they all had negative margins and nodes post-surgery (negative nodes were determined by pathological staging of a staged neck dissection two weeks post-TORS). In the event that patients do have positive nodes, the adjuvant radiation dosage needed (60 Gy) will be smaller than primary radiation treatment (70-72 Gy), minimizing side effects.

At other centers, reported rates of temporary tracheotomy in patients who undergo TORS range from 3% to 31%, with an average time to decannulation of seven days.4,11,15 The use of NG tubes for enteral feeding shows greater variance due to surgeon and center preference. In a case series of 45 patients at the Mayo clinic, NG tubes were used in 48% of patients, with a mean duration of 12.5 days.4 In another case series of 18 patients at the Mount Sinai School of Medicine, no feeding tubes were used and patients were fed a pureed diet one day after surgery.14 These data suggest an advantage over primary chemoradiation, where 17-30% patients are gastrostomy-tube dependent after one year due to dysphagia18, and open surgery, where all patients are typically kept on NG tubes for several weeks due to aspiration risk.

FUTURE DIRECTIONS

With the increasing popularity of robotic surgery, training guidelines and opportunities must be developed for current practitioners looking for certification. Similarly, as more residency programs acquire robot access, standardization of residency and fellowship curriculums will also be important. Currently, all Head and Neck Surgery fellows graduating from the University of Pennsylvania are trained in TORS. The University also runs a TORS training program for surgeons from around the world.

As surgeons become more comfortable with TORS, new and innovative procedures are being developed as well. One example is transaxillary thyroidectomy, where the thyroid gland is removed without having to create an unaesthetic cervical scar. The procedure was developed in Korea and has been performed in over 300 patients as of 2009.17

CONCLUSIONS

TORS is a safe and minimally invasive surgical technique with many applications in head and neck surgery. Benefits of TORS over traditional open surgery include hand tremor reduction, better visualization, and minimization of surgical trauma. Promising data from case series suggest possible benefit of TORS over primary chemoradiation at preservation of swallowing function after resection of oropharyngeal tumours. This offers a very advantageous quality of life consideration, especially for the increasing incidence of OPSCC in young HPV-positive patients.19 However, long-term oncological outcomes of oropharyngeal cancer after TORS resection are not yet available, and further studies are warranted.

REFERENCES